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RESEARCH PAPER

Socio-Economic Determinants of Child Under-Nutrition in Pakistan: A Measurement of Composite Index of Anthropometric Failure Using PDHS Micro Data

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ABSTRACT

The main aim of this research paper is to construct composite index of anthropometric failure (CIAF) for Pakistan by using Pakistan Demographic and Health Survey 2017-18. Further, this paper also investigates the socio-economic determinants of child undernutrition in Pakistan. Child undernutrition is a worldwide issue that needs to be tackled globally. We have applied Logistic regression analysis to find empirical results. The present study has used wealth index, mother's education, and source of drinking water, type of toilet facilities, family size and access to bank account as determinants of child undernutrition. The outcomes of this study have confirmed the positive and significant role of economic factors including wealth index and access to bank account with respect to child nourishment. Overall, every second child of the country is malnourished. The results show that, in Pakistan, around 33 percent children are stunted, 11 percent are wasting, and 21 percent are underweight. For the better future of country and to ensure efficient & productive human capital available in future, the policy makers should ensure the child development specific policies. The adults' needs and children needs are not similar, so the policies for poverty eradication and economic welfare may not be sufficient for taking the children out from the malnourishment and chronic diseases.

KEYWORDS Anthropometric Failure, CIAF, Stunting, Child Nutrition, Socio-economic factors, Pakistan

Introduction

Child undernutrition is a worldwide issue that needs to be tackled globally. This issue need to be addressed as major source of morbidity. Malnutrition is the biggest hindrance in attaining the SDGs. A country can attain the sustainable development by addressing the causes of undernutrition (WHO, 2016). Decreasing the number of child undernutrition would help in attaining Sustainable Development Goals. Undernutrition is defined as the outcome of insufficient food intake (hunger) and repeated infectious diseases (UNICEF, 2006). In 2021, a combine report published by World Health Organization (WHO) and UNICEF explaining that in early childhood not eating sufficient food and lack of nutrient intake are the causes of chronic undernutrition (WHO & UNICEF, 2021). Economic status of the country plays vital role in expressing the status of children's health and their nutritional requirements (Arif & Arif, 2012). The children's performance at school is also directly linked to their food intake and nutrition. According to the global nutrition report, the trend of children experiencing stunting and underweight is rising in developing countries (GNR, 2020).

Following table demonstrates the global proportion of children experiencing wasting, stunting and overweight. The situation is alarming and needs serious reviews.

Table 1
Global Trends of Child Malnutrition in 2020

Stunted	149.2(million)
Wasted	45.4 (million)
Overweight	38.9(million)

Table 2
Intensity of Severe Stunting, Severe Wasting and Severe Overweight in Children

Region	**Wasted**		**Stunted**		**Overweight**	
Year	**2000**	**2020**	**2000**	**2020**	**2000**	**2020**
Asia	8.9%	2.9%	37.0%	21.8%	4.5%	5.2%
Africa	6.0%	1.5%	41.5 %	30.7%	6.2%	5.3%
Europe	-	-	6.6%	4.5%	8.1%	8.3%
Latin America	1.3%	0.3%	18.0%	11.3%	6.8%	7.5%

The numbers in above table show the percentage of under-five year's age population across the world. As per the Global Hunger Index, around the world almost 690 million individuals are undernourished. The children who experience stunting and wasting are 144 million and 47 million respectively (GHI, 2020). South Asia and South Africa have the highest scores of undernutrition and their hunger scores are recorded to be 26.6 and 27.8 in 2020 (GHI, 2020). It can be seen that Pakistan has the highest stunted percentages among these neighboring countries. Furthermore, Pakistan has also the highest percentages wasted children after Afghanistan, Bhutan and Maldives.

Approximately 6,700 infant died on daily basis across the globe and the infant mortality rates are declined to 2.4 million in 2019, while it was 5.0 million in 1990 (CMR, 2020). Nearly 5.2 million children died in 2019, out of which 2.4 million deaths occurred in first month of life, 1.3 million deaths happened at the age of 1 to 4 years and 1.5 million deaths were registered at the age of 1 to 11 months (CMR, 2020). Moreover, in Pakistan infant mortality rate 56 infant deaths per 1000 live births in 2019. South Asian region is facing the higher under-five mortality rates, for example, 1.5 million deaths due to insufficient nutrition (CMR, 2020). In Pakistan, 19 percent children are having diarrhea between the ages of five years (DHS, 2017-18). According to national nutrition survey, 11.8 percent adolescent girls and 21.1 percent boys are underweight in Pakistan and taking insufficient amount of nutrition at the age of 10 to 19 years which lead to stunting, underweight and wasting (NNS, 2018). Socioeconomic factors play pivotal role for prevalence of undernutrition (Ahmed, Afzal, & Imtiaz, 2020).

During covid-19 threats of malnutrition is increased in low and middle income countries due to food and wellbeing disturbance and supply shocks (Osendarp et al,. 2021).

Table 3
Global Situation of Malnutrition during Covid-19

Wasted	9.3 million
Stunted	2.6 million
Child death case	168000 (numbers)
Anemia case	2.1 million
Children with low BMI	2.1 million

The reported cases of child deaths, anemia cases, low BMI, stunted and wasted are listed in above table during Covid-pandemic. This study is important in context of Pakistan because this study may help in exploring the socio-economic factors associated to undernutrition. To meet the sustainable development goals this study may highlighting the factors that are sufficiently contributing towards achieving better child nutrition, which obviously helps the policy makers to find a way to improve the human development index of the country.

Different studies in Pakistan measured undernutrition by using different estimators, for example body mass index, weight for age and height for age etc. The contribution of this paper is the construction of Composite Index of Anthropometric Failure (CIAF) for Pakistan by using PDHS household data, this index was initially introduced by Svedberg (2000) and later modified by Nandy et al., (2005). So the objectives of the study are to measure child undernutrition by estimating the Composite Index of Anthropometric Failure (CIAF) by using PDHS micro data for Pakistan. Further, to investigate the socio-economic factors of child undernutrition in Pakistan. This paper has four sections. The next section provides details on literature review. The third section discusses research methodologies applied for finding the desired outcome, while the fourth section covers results. The final section concludes the paper with suitable policy recommendations.

Literature Review

Measurement of Child Undernutrition

Deficiency of zinc, iron and iodine contributes to undernutrition and death. Absence of iron, zinc and vitamin are the reasons behind malaria and morbidity, which raise the burden of diseases (Laura, Richard, & Black, 2003). Malnourished women is gives birth to unhealthy child. Thus the poverty cycle is proceed (Blossner & Onis, 2005). When children suffer from undernutrition they are prone to catch malaria and diarrhea. Deficiency of micro nutrition is also a major cause of morbidity (Caulfield, Richard & Black, 2004). In developing region, the insufficiency of iron and vitamin A are the key reasons behind the undernutrition (Mashal et al,. 2008). Status of children's who experienced stunting, underweight and wasting were as 26.6percent, 63.3percent and 50.0percent, respectively in west Bengal, India (Mandal & Bose, 2009). In Nagpur city of India absence of mother's education, lack of immunization and child morbidity were caused the anthropometric failure in children. Overall presence of undernutrition among children in slum of Nagpur was 58.59 percent (Dhok & Thakre, 2016). The number of children's who got butter as prelacteal food was experienced wasting in Ethiopia (Fentahun et al,. 2016). In Bangladesh children's were experiencing stunting, underweight and wasting as 11.2%, 16.3% and 12.0% respectively. The common reasons behind the presence of morbidity were cough, diarrhea and fever in Bangladesh (Debnath et al., 2018).

In pastoral societies of Ethiopia children's were experiencing stunting, underweight and wasting as 43.1 percent, 16.2percent and 16.2percent, respectively. The study concluded that advancing use of family planning, vaccinated child and access to information are essential for child health in pastoral societies (Gebre et al., 2019). Children with different anthropometric failure were highly experiencing the risk of passing out. The rates of morbidity and undernutrition were decreased by decreasing the rate of poverty and by improving standard of living that left positive impacts on health (Nandy et al,. 2005). Access to nutrition, education and the wealth were the characteristics that helped to increase anthropometric absence. The health facilities were not enough for the reduction of undernutrition in Sub Saharan Africa than South Asia. The number of undernourished mother was higher in South Asia than the Sub-Saharan Africa (Harttgen & Misselhorn, 2006). Acute respiratory infection and diarrhea were the diseases found in children which caused illness of children in Kabul. Essential material requirements, lack of mother's education and absence of maternal autonomy were negatively linked with child health in Afghanistan (Mashal et al., 2008). Father's education is linked with the vaccination of the children and mother's education had a long term connection with the health of child which improved the health of child (Aslam and Kingdon, 2012).

Child Malnutrition in Pakistan

In case of Pakistan, there was a huge difference in lifestyle, income status, food intake and nutritional status of children between rural and urban population. Results showed that

status of children who experienced stunting, underweight and wasting as 36.1 percent, 33.9 percent and 45.3 percent, respectively in Faisalabad (Anwer and Awan, 2003). Morbidity and mortality were two indicators used for the measurement of child health and child sickness during the previous two weeks. Food certainty, absence of nutrition instruction and the poverty were key challenges in health and wellbeing (Arif, 2004). Children experienced stunting, underweight and wasting as 8percent, 14percent and 8percent, respectively in Mingora city of Swat. Malnutrition among preschool children was low in Mingora (Afridi, Khushdil & Ehsan, 2014). Women were overweight in forty nine districts and underweighted in one hundred and six districts of Pakistan. If mothers had good height, weight and had more than ten years of education than children were nourished better (Cesar et al., 2015). Lack of vitamin A had substantial impact on the underweight. Underweight was increasing with the passage of age and also due to insufficient feeding. Low parental education was also leading cause of undernutrition (Tariq et al., 2018). Male kids had more danger of malnutrition instead of female children. Incomplete vaccination, low mothers education and low income status of families were linked with malnutrition (Ahmad, Azul & Imia, 2020). Researcher conducted studies in all four provinces (Punjab, KPK, Sindh and Baluchistan) of Pakistan but the tribal area (FATA) were generally neglected area by researcher in Pakistan. No single study is conducted from FATA (Asim and Nawaz, 2018).

Conceptual Framework

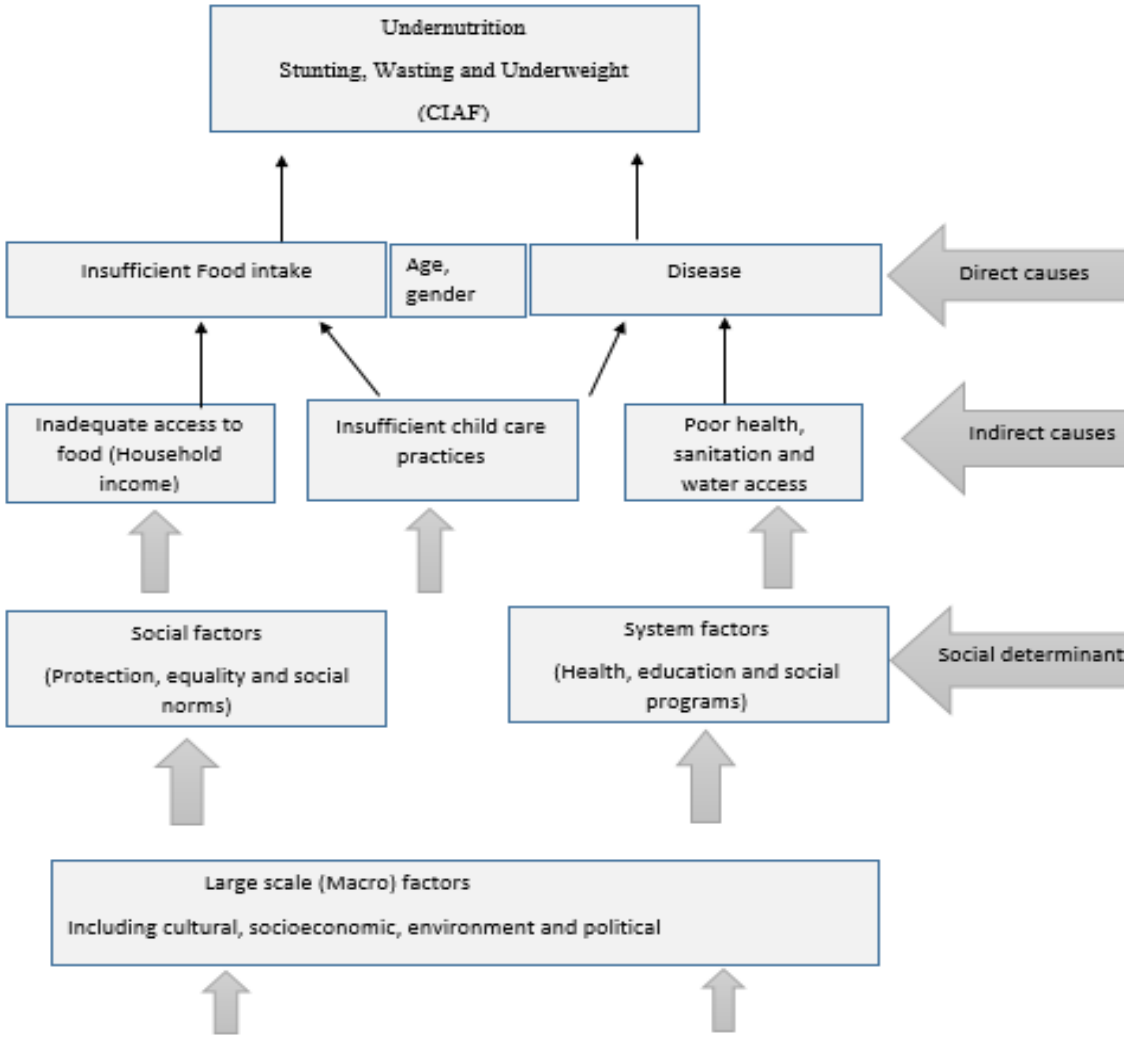

Figure 1 A Conceptual Framework for Factors of Child Undernutrition

A conceptual framework is established by UNICEF to identify the factors of child undernutrition at household level. As per the WHO, the children experience four types of child undernutrition including insufficient minerals, stunting, wasting and underweight (Zikusooka, 2019).

To sum up, the above literature has been a strong debate on the socioeconomic factors of child undernutrition. When it specifically comes to the situation of Pakistan a very few studies carry to analysis the socio-economic determinants of child undernutrition. The available literature expresses that, for Pakistan data, child undernutrition primarily is measured by weight for age, and/or height for age (Arid, 2004) and body mass index (Tariq et al., 2008). Apparently, the literature suggests that the measurement of undernutrition by the using CIAF provides inclusive prevalence of under nourishment as a single estimator (Nandy et al., 2005; Khan and Raza, 2014).

Material and Methods

Data and Sampling

This study used micro data of Pakistan Demographic and Health Survey (PDHS) 2017-18. This survey data representing the population of Pakistan including Azad Jammu and Kashmir (AJK), Islamabad Capital Territory (ICT) and four provinces of Pakistan along with tribal areas (FATA) which were not included in the 2012-13 PDHS survey. In PDHS 2017-18 total 14,540 households were interviewed with the response rate of 96 percent in Pakistan. There was total 580 clusters and 28 households were picked from each cluster.

CIAF (Composite Index of Anthropometric Failure)

World Health Organization suggests that three indicators wasting, stunting and underweight can be used for the measurement of child undernutrition (Dhok & Thakre, 2016). Individually these indicators were not providing the complete information of child undernutrition (Dhok & Thakre, 2016). Composite index of Anthropometric failure was first introduced by the Peter Svedberg (Svedberg 2000; Nandy et al., 2005). So, in the context for calculation of CIAF he established six groups of children ranging from A to F. Later on, Nandy redesigned Svedberg model by introducing an extra group with the name of Y (underweight only) and eliminated the group A (Nandy et al., 2005). Y group only had those children who were just underweight. Finally he modified the groups and redesigned as group B to Y.

Table 4
Categorization of Children Groups with Anthropometric Failure

Groups of children	References
A. No failure	(Nandy & Miranda, 2008)
B. Having wasting only	(Nandy & Miranda, 2008)
C. Underweight and Wasting	(Miranda & Nandy, 2008)
D. Stunting, Wasting and Underweight	(Miranda & Nandy, 2008)
E. Underweight and Stunting	(Nandy & Miranda, 2008)
F. Having stunting only	(Nandy & Miranda, 2008)
Y. Having Underweight only	(Nandy & Miranda, 2008)

Undernutrition was measured by the CIAF (groups B-Y). The CIAF included weight for height as WHZ, height for age as HAZ and weight for age as WAZ. If Z-score value is less than -2 standard deviation, it shows moderate stunting, wasting and underweight (Savanur & Ghugre, 2015). If child's height for age, weight for height and weight for age, z-score value is less than -3 standard deviation it shows severe stunting wasting and underweight (Savanur & Ghugre, 2015). This study follows follow Svedberg theory. Prevalence and overall burden of undernutrition is calculated by Composite Index of Anthropometric

Failure by using the dataset of Pakistan Demographic Health Survey 2017-18. As per indicator, rate of undernutrition is calculated from WHO z-score and minus two standard deviation is the threshold level. The data is analyzed by using WHO Anthro software.

Measurement of Composite Index of Anthropometric Failure

Composite index of anthropometric failure is used to measure nutritional status of children (Nandy et al., 2005).

Step-1 Selection of Variables

Child's height, weight and age are used to calculate Z-score value. Weight of child is measured in kilogram (kg), height is taken in centimeter and age is in months (0 to 59).

Step-2 Calculation of Z-Score Values

In this study WHO Anthro-Software is used to calculate WHZ (weight for height), HAZ (height for age) and WAZ (weight for age).

Step-3 Calculate Seven Groups of Children

After the calculation of Z-score value next step is to establish the seven groups of children. In this study we used IBM SPSS Statistics to establish seven groups of children. First we labeled WHZ (weight for height), HAZ (height for age) and WAZ (weight for age) and ran SPSS syntax to create seven groups of children ranging from A to Y.

Step-4 Two Standard Deviation (minus)

Minus two standard deviation shows moderate stunting, wasting and underweight in children (Savanur & Ghugre, 2015).

Step-5 Three Standard Deviation (minus)

Minus three standard deviation shows severe wasting, underweight and stunting in children (Savanur & Ghugre, 2015).

Step-6 Calculation of CIAF

To calculate composite index of anthropometric failure, value 0 and 1 is assigned. The value '0' is assigned to not stunted, not wasted and not underweight whereas '1' assign to stunted, underweight and wasted. CIAF is the binary variable. This analysis is performed on STATA 14.0.

Model Specification

This study investigates the socio-economic determinants that affect child undernutrition in Pakistan by using micro data of Pakistan demographic and health survey (PDHS) 2017-18. The undernutrition is measured by using the Composite Index of Anthropometric Failure as a proxy variable (Nandy & Miranda, 2008).

$$\boldsymbol{CU_i = \beta_0 + \beta_1 ME_i + \beta_2 TF_i + \beta_3 WI_i + \beta_4 FS_i + \beta_5 SDW_i + \beta_6 BACC_i + u_i} \text{ ..... } \boldsymbol{(1)}$$

In this model, the subscript i denotes different cross sectionals. β_0 Show to the intercept coefficient and β_1 , β_2 , β_3 , β_4 , β_5 and β_6 are slope coefficient. In this model, $u_i$is the error term, the dependent variable is child undernutrition. Composite index of

Anthropometric Failure is be used for the measurement of child undernutrition (Savanur & Ghugre, 2015; Nandy & Miranda, 2008). Composite index of Anthropometric Failure is a dichotomous variable, assigned values of 0 & 1. CIAF takes the value of 1 if children are either underweight, stunted and wasted or 0 if otherwise. Here, ME is depicting mother's education that includes no access to education, access to primary, secondary or higher education. In this model, TF means toilet facility that include various types of facilities. The variable, WI, represents wealth index that represents wealth status of household. The variable, SDW stands for the sources of drinking water that is binary in nature and may take value one for improved source of drinking water, and zero otherwise. Other variable FS is stand for the family size. Moreover, BAAC stands bank account of household head as household have access to bank account or not. In this model the dependent variable is binary in nature, so the logistic regression model is most appropriate technique for econometric analysis (Gujrati et al., 2012). The model is being followed by this functional form.

$$L_i(\mathrm{P}) = log\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_i X_i + \beta_k X_k \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$= \frac{1}{1+e^{-(\beta_0+\beta_1 ME_i+\beta_2 TF_i+\beta_3 FS_i+\beta_4 BAA_i+\beta_5 WI_i+\beta_6 CF_i)}} \ldots\ldots\ldots\ldots (3)$$

Here, in equation no2.

P_i = is the probability of children experiencing undernutrition

β_0 = is intercept

β_i = shows effects of independent variable of the model

X_i = independent variable of the model

Cross-sectional dataset is taken by Pakistan demographic and health surveys 2017-18.

Estimation Procedure

The PDHS (Pakistan demographic health survey 2017-18) used for constructing Composite Index of Anthropometric Failure. Wealth index and access to bank account are economic variable. In this study cross sectional data is used. In this research for calculating Z-Score, WHO Anthro-software is used. The variables are in binary form so binary logistic regression is used for the measurement of Composite Index of Anthropometric Failure.

Results and Discussion

Table 5
Categorization of Children Groups with Anthropometric Failure

Group	Categorization of children	Percentage
A	No failure	59.5%
B	Having Wasting only	3.6%
C	Underweight and Wasting	4.0%
D	Stunting, Wasting and Underweight	2.9%
E	Underweight and Stunting	12.5%
F	Having Stunting only	16.5%
Y	Having Underweight Only	0.9%

The categorization of children from group A to Y is shown in above table. It shows that around 40 percent children are suffering from any of the under-nutrition conditions like stunting, wasting and/or under-weight.

Table 6
Underweight, Stunted and Wasted Percentage of Children

Groups	CIAF	Percentage
A	Child Under Nourished	42.84%
B	Child Nourished	57.16%
C	Not Underweight	79.6%
D	Underweight	20.4%
E	Not Stunted	67.4%
F	Stunted	32.6%
G	Not Wasted	89.2%
H	Wasted	10.8%

The above table shows that children experience stunting, wasting and underweight as 32.6 percent, 10.8 percent and 20.4 percent, respectively in Pakistan. In Pakistan, 57.16 percent children are not experienced child undernutrition and 42.84 percent children are suffering from undernutrition. Every second child have experience any type of undernutrition in Pakistan.

Table 7
Severe Underweight, Severe Stunted and Severe Wasted Percentage of Children

Weight for Age	**Percentage**
Not Severe Underweight	92.0%
Severe Underweight	8.0%
Height for Age	**Percentage**
Not Severe Stunted	83.0%
Severe Stunted	17%
Weight for Height	**Percentage**
Not Severe Wasted	95.2%
Severe Wasted	4.8%

The above table shows percentage of severe stunted, severe or not severe underweighted children, severe or not severe stunted (but moderate) in Pakistan.

Table 8
Logistic Regression Model

CIAF	Coefficient	Std.Err	Significance	Z
Family Size	.0449053**	.0102674	0.000	4.37
Wealth Index				
Poorer	-.6364689**	.1218605	0.000	-5.22
Middle	-.9013115**	.1346532	0.000	-6.69
Richer	-.9705525**	.1468571	0.000	-6.61
Richest	-1.422839**	.1720209	0.000	-8.27
Water Source	-.2159001**	.0811167	0.008	-2.66
Toilet Facility	-.1262027**	.0537947	0.001	-2.35
Mother Education				
Primary edu	-.4666242**	.1254392	0.000	-3.72
Secondary edu	-.32588924**	.1172182	0.005	-3.78
Higher edu	-.4949211**	.1172182	0.001	-3.38
Bank Account	-.2747987**	.0966516	0.004	-2.84

Number of Observation= 14,540
LR chi2(10)=1629.52
Prob>chi=0.0000
Pseudo R= 0.2

***p<0.01, **p<0.05,*p<0.1

The result of regression elaborates when household family size move from lower to higher number of household more likely the rate of child undernutrition is going to increase, it show to the positive relationship between family size and composite index of anthropometric failure. There is a negative relationship between wealth index and composite index of anthropometric failure at household level. When household gets richer, household is less likely to have child undernutrition. The result shows that higher the wealth of household, lower the chance of child undernutrition. The results shows there is an inverse relationship between water source and composite index of anthropometric failure at household level. The results shows that there is an inverse relationship between toilet facility and composite index of anthropometric failure at household level. When household shifts from poor to improved toilet facility; it is less likely to have child undernutrition and diarrhea. The result of regression shows that when mother education move from primary to secondary education less likely the rate of child undernutrition is increase, there is a negative relationship between mother education and composite index of anthropometric failure at household level. When household have access to financial institutions holding bank account is less likely to have child undernutrition, there is a negative relationship between access to bank account and composite index of anthropometric failure at household level. The rich family have more money to spend on their child health.

Conclusion

This study aims to measure child undernutrition by estimating the Composite Index of Anthropometric Failure (CIAF) and to investigate the socio-economic factors of child undernutrition in Pakistan. For analysis this study used WHO Anthro software, Stata 14 and IBM SPSS software. This study used logistic regression to identify socioeconomic determinants of child undernutrition. The outcome of study shows that children experience stunting, wasting and underweight as 32.6 percent, 10.8 percent and 20.4 percent, respectively in Pakistan. The outcome of study shows that children experience severe stunting, severe wasting and severe underweight as 17 percent, 4.8 percent and 8.0 percent, respectively in Pakistan. By conducting a regional analysis, it is found out that the tribal area FATA has the highest stunted percentage of children. Balochistan has the highest wasted percentage of children. Balochistan has the highest underweighted percentage of children. Policies should be adopted to increase the education of mothers and all the members of household.

Government should give awareness about family size and resources utilization which put impact on child undernutrition. Increase the number of working opportunities for each of the household member and ensure women empowerment. Government should increase to the multi-source of income. When household have access to financial institutions holding bank account is less likely to have child undernutrition, there is a negative relationship between access to bank account and composite index of anthropometric failure at household level

The Government of Pakistan needs to overcome the poverty and income inequity from the country. A well-educated mother can bring positive nutritional outcome to her baby. Mother's education is directly associated to child dietary intake. Government should wider the access of financial institutions, include savings banks and micro finance bank.

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